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ABSTRACT

Two experiments investigated the role of children's spontaneous conceptual "biases" in pictorial discrimination learning. The results suggested that such biases may serve either to facilitate or to interfere with discrimination learning. Moreover, in each experiment, age by treatment interactions revealed that in comparison to the behavior of older children (sixth graders), that of younger children (kindergartners) is governed more by the perceptible than by the functional attributes of stimuli. These data are in complete accord with Bruner's view of cognitive development. (Author)

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TECHNICAL REPORT NO. 292

THE EFFECT OF CHILDREN'S SPONTANEOUS STIMULUS PREFERENCES ON DISCRIMINATION LEARNING

REPORT FROM THE PROJECT ON CHILDREN'S LEARNING AND DEVELOPMENT

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Technical Report No. 292

THE EFFECT OF CHILDREN'S SPONTANEOUS STIMULUS PREFERENCES ON DISCRIMINATION LEARNING

by

Linda J. Ingison and Joel R. Levin

Report from the Program on
Children's Learning and Development

Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
Madison, Wisconsin

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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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I
Introduction

Bruner and his coworkers (Bruner, 1964; Bruner, Olver, & Greenfield, 1966) have presented a view of cognitive development which posits that children deal with external events by means of successively more sophisticated and differentiated modes of representation. In this view, as young children develop from earlier (iconic) modes through later (symbolic) modes, they move from being governed primarily by the perceptible attributes of stimuli (such as their color, shape, size, and texture) to becoming more receptive to certain higher-order functional attributes (such as what the stimuli do or what they are used for).

Data in support of this proposition have been provided by two studies reported in Bruner et al. (1966). Results of both studies revealed the same trend: younger (six-year-old) children exhibited a preference for classifying stimuli on the basis of their perceptible attributes whereas older (11- and 12-year-old) children revealed an increasing preference for classifying stimuli on the basis of their societally acceptable functional attributes. These age-related changes in spontaneous conceptual groupings reflect rather strong "biases" to encode certain types of attributes (perceptible or functional).

Based on these assumptions, two experiments were designed to demonstrate that such spontaneous stimulus preferences are reflected in subjects' spontaneous learning behavior. A discrimination-learning task was chosen since it is (a) a simple nonverbal task, easily understood even by very young children (e.g., Wilder & Levin, 1973); (b) well grounded in psychological theory with respect to the variables and processes affecting performance (Ekstrand, Wallace, & Underwood, 1966); and (c) conducive to the type of experimental manipulations desired here.

In a discrimination-learning task, S's task is to choose the "correct" item (as arbitrarily designated by E) in each of several pairs. Since this task involves interitem discriminations, it is possible to affect its difficulty by including items which possess some degree of orthographic, acoustic, or semantic similarity (cf. Wallace, 1972). Although such manipulations have typically been made using verbal materials with adults, it seemed possible to adapt these to pictorial materials for use with children.

Accordingly, in Experiment I, lists were constructed in which the pictorial stimuli were highly similar, either on a perceptual or a functional basis. Perceptually-similar items were drawn exactly the same shape and size but were conceptually unrelated (e.g., a playing card and a door); whereas functionally-similar items were perceptually-dissimilar members of the same taxonomic category (e.g., a piano and a trumpet). Utilizing age groups previously found to exhibit primarily perceptual or functional biases (cf. Bruner et al., 1964) an age by list-type interaction was expected such that in comparison to older children, younger children would experience relatively greater difficulty on the perceptual list than on the functional list.

II
Experiment I

Method

Subjects and Design

Subjects were 64 children attending elementary school in a semi-rural community in Wisconsin. Thirty-two children were selected from each of grades K and 6. The basic design of the study was a 2 (Grades: K and 6) x 2 (List types: perceptually- or functionally-similar drawings) factorial. Within each grade, 8 Ss of each sex were randomly assigned to the two list types. Sample size was based on the desire to have power of about .80 to detect the predicted interaction if it produced an effect equal to at least 2/3 of a within-cell standard deviation.

Materials

A total of 68 artist's line drawings were chosen for use in the study. Each discrimination list consisted of 15 pairs of drawings, approximately 2 inches long, reproduced onto 5 x 7 inch card stock. Pairs were presented horizontally on the cards, 2 inches apart. For the perceptually-similar list, 5 pairs were drawings of rectangular objects (e.g., playing card-door), 5 were of circular objects (baseball-wheel), and 5 were of oblong objects (pencil-nail). For the functionally-similar list, 5 pairs were drawings of musical instruments, 5 of animals, and 5 of foodstuffs. Four unrelated pairs were used for a practice list. The order of presentation of the pairs within each list was mixed.

Procedure

Each S was tested individually in a room within the school building. Subjects were instructed that their task was to learn the correct item for each pair. Four practice pairs were presented in order to ensure that S understood the task and instructions. An anticipation paradigm was used, in which one complete trial was presented for study with no response required. The initial trial was followed by four test trials, in which S responded by pointing at one of the two drawings. Feedback was given by means of a yellow dot under the correct item on the card immediately following. The feedback card contained both the correct and the incorrect item. Each card was presented for approximately 4 seconds, and Ss were required to respond to each pair.

A unique random order of the items was used for each trial. The position of the items was such that the correct item for each pair appeared equally often in the right- and left-hand positions across the four test trials. Further, within each trial, the correct items were approximately equally distributed between the left- and right-hand positions (one trial consisting of 15 pairs).

Results

A 2 (grades) by 2 (List types) by 2 (Sexes) by 4 (Trials) multivariate repeated measures analysis of variance was conducted on the data. No effects due to the sex factor were significant (all p's > .05), and the combined male-female data are summarized in Figure 1. In these data, the grade main effect was significant ($p < .001$), and the predicted grade by list-type interaction was significant in the expected direction ($t = 1.71$, $df = 56$, $p < .05$, one-tailed). Within Ss, the main effect of trials was significant ($p < .001$), as was its interaction with grades ($p < .05$), with the latter effect traced to the differing cubic components of the performance curves in the two grades. However, trails did not interact with the previously noted grade by

list-type effect ($F < 1$).

Thus, perceptual and functional similarity differentially influenced the learning of younger and older children and, as may be seen in Figure 1, in a manner specified by the hypothesis. In other words, in comparison to the performance of sixth graders, that of kindergartners was relatively worse on the perceptually-similar than on the functionally-similar list. Exactly the same conclusion is reached when the first-trial data are analyzed separately (to discount the possibility of a ceiling effect in the sixth-grade sample).

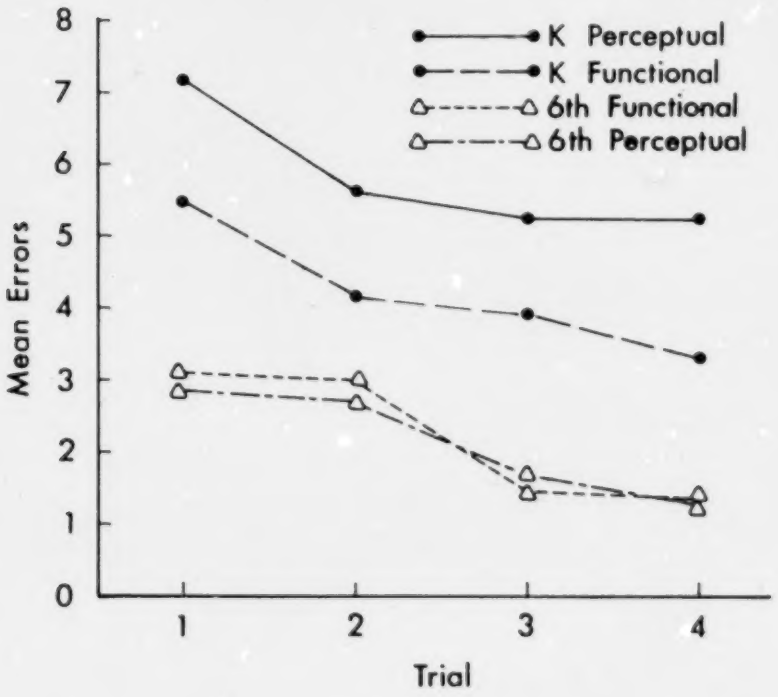

Figure 1. Mean number of errors per trial, by grade and list type (Experiment I).

III
Experiment II

In Experiment I it was demonstrated that the discrimination learning of younger and older children could be differentially affected by the type of learning materials provided. In particular, learning was shown to be retarded when the stimulus materials were similar on a dimension assumed to reflect Ss' spontaneous preferences, especially at the younger age. It should be possible, however, to reverse this result and show that Ss' spontaneous preferences can be exploited to assist (rather than to interfere with) their performance. Such a tack was taken in Experiment II, in which lists were constructed so as to facilitate performance when combined with Ss' biases. Moreover, in order to determine whether any facilitation occurred, a control list (which was lacking in Experiment I) was also included.

Method

Subjects and Design

Subjects were 120 elementary school children from a semi-rural community in Wisconsin. Sixty children were chosen from each of grades K and 6. The basic design was a 2 (Grades: K and 6) x 3((List types: perceptually- or functionally-cued lists and an unrelated control list) factorial. Within each grade, 10 Ss of each sex were randomly assigned to the three list types. For the two experimental lists (i.e., the perceptual and the functional lists), 5 Ss of each sex in each grade were equally divided between two different list versions (as described below).

Materials and Procedure

A total of 58 artist's line drawings were chosen. Although complete overlap in drawings between Experiments I and II was not possible due to the requirements of the task, the same drawings were used in both experiments wherever possible. Each discrimination list contained 15 pairs of drawings prepared and presented in the same manner as in Experiment I. A total of 5 lists was prepared: two versions each of the perceptual and the functional list, and one control list. All 5 lists shared in common 10 pairs of drawings unrelated in either perceptual or functional attributes ("noncued" pairs). In the perceptual and functional lists, the remaining 5 pairs contained an appropriately cued item paired with an unrelated drawing ("cued" pairs). Thus, in one perceptual list (P1), 5 circular objects were paired with 5 unrelated drawings, with the circular object designated as "correct" in each pair. Similarly, 5 rectangular objects (P2), 5 musical instruments (F1) and 5 foodstuffs (F2) were designated "correct" and paired with the same unrelated drawings in the remaining experimental lists. In the control list, 5 additional unrelated drawings were selected and designated "correct" in these pairs.

A practice list containing 4 unrelated pairs was administered in all conditions. In the experimental task the order of the pairs was random, subject to the constraint that "cued" pairs were equally spaced throughout the list. Positioning of the correct items in the right- and left-hand positions followed the procedure of Experiment I. The procedure of the present experiment followed that of Experiment I, with the exception that five test trials (rather than four) were administered following the initial study trial.

Results

If Ss were aware of available cues, facilitation should be observed for "cued" pairs in the experimental conditions, since items with the same perceptual or functional characteristics in different pairs were always "correct." Further, according to the differential preference

hypothesis, perceptual cues should be more readily perceived by younger Ss and functional cues by older Ss, leading to an interaction opposite in direction to that of Experiment I: viz., larger performance differences between kindergartners and sixth graders on the functionally-cued than on the perceptually-cued list would be expected.

Considering the 5 "cued" pairs, the interaction of interest is depicted in Figure 2, having been collapsed over sex and the two versions of the experimental lists. In these data, the planned interaction contrast involving grades and perceptual vs. functional list types was significant in the predicted direction ($t = 1.90$, $df = 100$, $p < .05$, one-tailed). What is striking about Figure 2 is that while there are large age differences in performance on the functional list, these virtually disappear when perceptual cues are provided. In particular, by Trial 2 the kindergartners given the perceptual list have

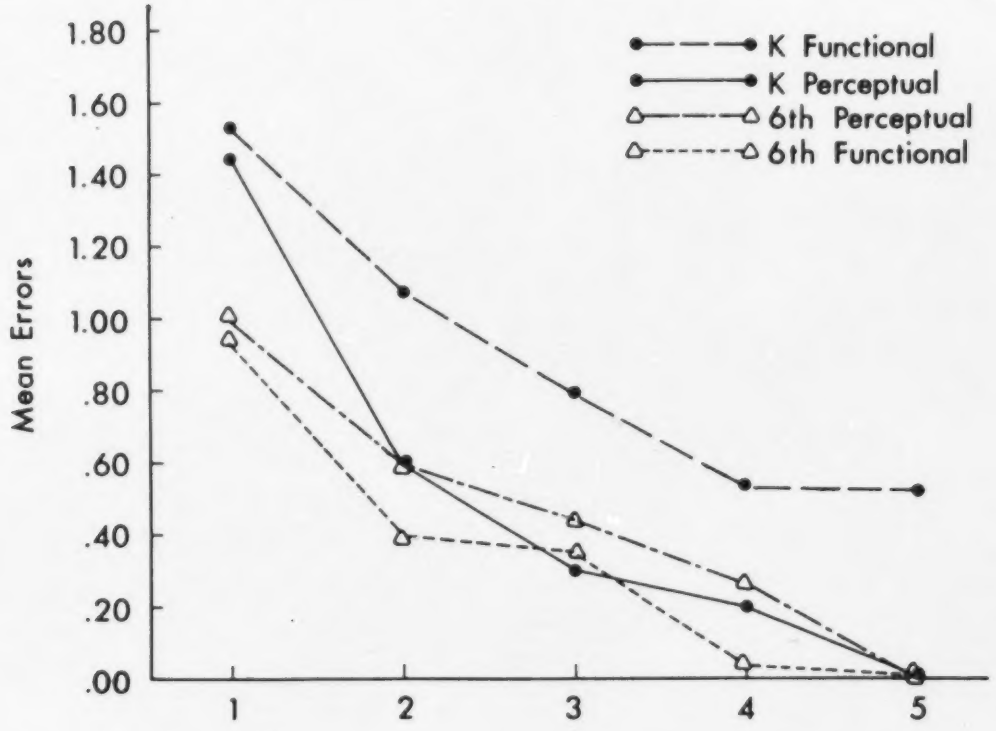

Figure 2. Mean number of "cued" item errors per trial, by grade and list type (Experiment II).

caught up with the sixth graders given the same list, and by Trial 3 they have passed them. The improved performance of kindergartners given perceptual cues is also documented on the basis of Dunnett tests (comparing perceptual and functional lists with the control list) conducted within each grade ($\alpha = .05$, one-tailed)--cf. Table 1. On the other hand, neither the performance of kindergartners given functional cues nor that of sixth graders given either type of cue was significantly facilitated relative to the respective control-list performance (even though all differences were in the expected direction). Although improvement over trials occurred across conditions ($p < .001$), the previously discussed interaction was not significantly affected by trials ($F < 1$).

Considering the 10 "noncued" pairs, both grade and trial main effects were observed (both p's $< .001$). In contrast to the "cued"-pair analysis, however, the grade by perceptual vs. functional list-type interaction was negligible ($|t| < 1$), as were the Dunnett comparisons within each grade.

TABLE 1

MEAN NUMBER OF ERRORS ACROSS TRIALS ON THE FIVE "CUED" PAIRS OF EACH LIST (EXPERIMENT II)

	Control	Perceptual	Functional
K	4.56	2.55	4.55
6th	2.90	2.30	1.75

IV
Discussion

It was predicted that the child's level of cognitive development may determine the type of information encoded and used in approaching a problem. These preferences have been shown to be powerful enough, at least at the kindergarten level, to facilitate or interfere with learning of a discrimination task. These results are in general agreement with predictions based on Bruner's (1964; Bruner, Olver, & Greenfield, 1966) theory of cognitive development.

Thus, like the results of an earlier study (Levin, Ghatala, Wilder, & Inzer, 1973) where discriminations between homonymous or synonymous verbal items were found to be differentially affected by the type of instructions given to Ss, in the present study Ss of different ages responded differently to perceptually-based and functionally-based pictures--a consequence of these Ss' apparently different response biases brought with them into the experiment. And since performance on a discrimination learning task is assumed to reside in successful subjective frequency discriminations (Ekstrand et al., 1966), it should be possible to demonstrate corresponding interactions between instructions and materials, or between age and materials, in tasks involving simple frequency judgments. Efforts in this direction are currently underway.

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